The Science of Reading and Its Educational Implications

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Who am I? I conduct research on reading and language here:

Articles, other information available:  [http://lcnl.wisc.edu](http://lcnl.wisc.edu)
My own research

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<th>Brain circuits</th>
<th>Computational models</th>
<th>Behavior</th>
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<td>Research at UW, Haskins Labs, Medical College of Wisconsin (MCW)</td>
<td>Statistical learning, connectionist “neural network” models</td>
<td>Children/adults, Acquisition/skilled performance, Non-impaired/dyslexic, Many languages and writing systems</td>
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People have been studying reading for a long time, in labs around the world.

Much is known.

- skilled reading
- learning to read
- brain bases of reading
- causes of reading impairments

many other issues

Reading Science: one of the big successes of modern cognitive science/neuroscience

Much remains to be learned but there is

broad consensus about main properties, phenomena
At a certain point (or a certain age) you begin to wonder:

*If we know so much about reading, how come there are so many poor readers?*
America, We Have A Problem

Many indicators show the same thing:

Overall literacy levels in the US are too low.

Many people have only very basic reading skills.

We compare poorly to other “modern” countries with advanced economies.

Raising questions about

our abilities to manage ourselves
our abilities to compete globally
our abilities to meet challenges
In 2011:
OECD PISA Reading Results 2009

Wall St. Journal, 8/12/2010
Figure 1: Number of times the phrase “sputnik moment” was uttered on CNN, an American cable news network over a two year period. The large spike followed the release of results from the 2009 PISA assessment and coincided with President Obama’s 2011 State of the Union address.
National Assessment of Adult Literacy (2003)
This figure does not even show the 25% or so who score Below Basic. About 65% are Basic or Below Basic

• “The public schools are working very well for most students.”

• The US has always scored in the middle of the pack on the PISA assessment.

• The NAEP results are misleading. Test doesn’t capture what’s important.

• Everything would be fine if teachers were just allowed to teach.
How well are the public schools working for these children?

Why so many reading failures?

Outcomes are determined by many factors.

Some are extremely hard to address, like poverty.

What else could we be doing?

Does the science have anything more to contribute?
“The science of reading and its educational implications”? 

We all know these issues are too complex to do justice to them in one talk.

Maybe a few points that are worth pursuing further.
People talk about “gaps”. There are many “gaps”. Let’s talk about this one:

The Culture Gap between education and science.

Two cultures problem limits communication, cooperation

It’s holding us back.

But also hard to overcome.

Can this be fixed?
Lots of relevant research on how reading works.
Reviewed by Snow et al. 1998 (NRC report), National Reading Panel (2002), elsewhere.

• Little impact on curricula, classroom practices.

• Not a part of teacher, administrator, curriculum specialist’s own training

A person has to seek this information out, go to special events in places like New Haven CT, or try to find reliable resources on the Internet (which is hard!).

WHY??
Cultures of Science and Education are very different

In general (there are exceptions, including most people in this room),

Different views about how children learn, develop

Different views about the nature of reading

Different views about what counts as evidence for what works

Different ways of assessing progress.

These are cross-cultural differences, which are very difficult to bridge.
Illustration:

How do we know how reading works?

How children learn?

Which practices are effective?

Why some succeed and others struggle?

Careful observation?

See what works?

Ask someone who’s successful?

Consult an authority?
I’m a scientist. I think more is required.

1. People’s intuitions often conflict, and our observations are deeply biased (cf. Kahneman).

2. Causal attributions are hard to make in a complex setting like a classroom.

3. Unseen forces: Misattributions regarding effects of experiences outside of the educational setting (e.g., tutoring)

4. Most of what happens when we engage in activities like reading occurs without conscious awareness.

These mechanisms can’t be directly observed. They can be uncovered through systematic investigation, however.

That means: research.

   Sometimes confirms intuitions.
   Sometimes explanations are very non-intuitive.
There is a strong anti-science element in the culture of education

People are socialized to believe research can be ignored, discounted. Nothing of interest here, move along.

Scientists are very naïve about this.

We conduct, publish, explain research, and think the job ends there.

But, we’re shadowed by people who make a point of undoing the research for benefit of teachers, other educators, explaining what it “really” means, nullifying its impact.
WHAT REALLY MATTERS WHEN WORKING WITH STRUGGLING READERS

More Smoke and Mirrors: A Critique of the National Reading Panel (NRP) Report on "Fluency"

Stephen Krashen
Phi Delta Kappan (October, 2001)

In her review of the National Reading Panel's (NRP) report on phonics, Elaine Garan concluded that the report involved "a limited number of studies of a narrow population..." In this note, I will argue that this problem is not limited to the section on phonics: It also applies to the NRP's section on "fluency." It is only by omitting a large number of relevant studies, and misinterpreting the ones that were included, that the NRP was able to reach the startling conclusion that there is no clear evidence that encouraging children to read more improves reading achievement.
Lack of background knowledge leaves many people unprepared to evaluate scientific findings.

Vulnerable to fads, fallacies, frauds

In reading, there are a lot of them.

Lack of cross-cultural contact limits amount of research on translating research into classroom practices.
Pause:

So, blame the teachers?

NO.

Blame how teachers are taught?

I think so.
The costs of not knowing

What is dyslexia?
Does Dyslexia Exist?

JULIAN G. ELLIOTT AND SIMON GIBBS

In this paper we argue that attempts to distinguish between categories of ‘dyslexia’ and ‘poor reader’ or ‘reading disabled’ are scientifically unsupportable, arbitrary and thus potentially discriminatory. We do not seek to veto scientific curiosity in examining underlying factors in reading disability, for seeking greater understanding of the relationship between visual symbols and spoken language is crucial. However, while stressing the potential of genetics and neuroscience for guiding assessment and educational practice at some stage in the future, we argue that there is a mistaken belief that current knowledge in these fields is sufficient to justify a category of dyslexia as a subset of those who encounter reading difficulties. The implications of this debate for large-scale intervention are outlined.
Why Skepticism about “Dyslexia”? 

- People say: 
  - It can’t be defined precisely enough. 
    - same issues as for hypertension, autism, AD/HD, etc. 
  - It’s just poor reading, which we can already deal with. 
    - If this were true, there would be no debate 
    - It’s medicalizing normal variation (like “caffeine addiction” 
      or “restless leg syndrome”). 
  - Lack of knowledge among medical professionals 
    - Not part of their training either.
FEBRUARY 13, 2009

National reading expert comes to Baltimore County
A group of Baltimore County educators spent today in reading presentations by literacy expert Dr. Richard Allington, whom I spoke with for a recent story about independent reading programs.

Superintendent Joe A. Hairston introduced Allington, a professor of literacy studies at the University of Tennessee in Knoxville, as "the Bill Gates of reading."

He added that Allington is one of the few individuals in the country who truly understands the significance of that skill and has mastered the teaching of it -- "and is willing to share it with those of us who are in the trenches."

Allington does not mince words when it comes to his belief in the importance of properly teaching children how to read: allowing them to read what interests them, and giving them access to such material at their reading levels.

"There is no such thing as a learning disability or dyslexia," Allington told the group, citing research and his own 45-year experience of never finding anyone he couldn’t teach to read.
I CALL SHENANIGANS

SHENANIGANS HAVE BEEN CALLED
Does dyslexia exist?

Behavioral, neurobiological, genetic evidence suggests it does

Is dyslexia hard to identify?
Yes, in young children, when it would be most beneficial.

No checklist of symptoms.
Characteristic behaviors change over time.
Condition varies in severity.
May be co-morbid conditions (ADHD)
May be multiple causes.

In young children, hard to identify because
behavior overlaps with some non-dyslexics.
What happens to these children?

Parent is told “he’ll grow out of it.”
If he doesn’t, “Did you read to him when he was younger? Do you have any books at home?”

RTI: having effective interventions depends on understanding the origins of the problems.

In Wisconsin, a child with a neuropsych workup and diagnosis of dyslexia will usually be given an IEP; the classroom teacher is charged with developing relevant instructional activities.

The teacher usually does not have relevant training.
They do not know what works and what doesn’t.
They have other demands on their time.

Is this fair to the child OR the teacher?
If the child is lucky, he’ll come from a well-off family with an educated, informed parent (or two) who can find and pay for outside help.

Which works less well for the child who is already disadvantaged by being poor.

Outsourcing: a way to exacerbate effects of income inequalities.
Other examples of relevance of basic research, disconnect from practices/received wisdom
Classic issue: Do people read “visually” or “phonologically”?

Intuitions vary.

maybe different people use different strategies

maybe some people do both

maybe it depends on reading skill, writing system

How can you tell unless you do the studies?

Many behavioral experiments: Van Orden effect, visual tongue-twisters, etc.
Neuroimaging evidence

1. areas that primarily respond to the sounds of words (but not other sounds)
   “your mind’s ear”

2. areas that primarily respond to the spellings of words (but not other visual patterns)
   “the visual word form area”

In silent reading, both areas are activated.
- **Phonology**
  - SMG/STG

- **Spellings**
  - “visual word form area”
The interesting part:

Area that responds to phonology  SMG

Is also shaped by orthography (spelling). Many studies now.

How Does Learning to Read Affect Speech Perception?

Chotiga Pattamadilok,1 Iris N. Knierim,2 Keith J. Kawabata Duncan,3 and Joseph T. Devlin3
1Unité de Recherche en Neurosciences Cognitives, Université Libre de Bruxelles, B-1050 Brussels, Belgium, 2Max Planck Institute for Human Cognitive and Brain Sciences, Research Group “Neurocognition of Rhythm in Communication,” 1A 04103 Leipzig, Germany, and 3Cognitive, Perceptual and Brain Sciences and Institute of Cognitive Neuroscience, University College London, London WC1E 6BT, United Kingdom

Transcranial magnetic stimulation study
And, conversely,

Area that responds to orthography  OT-VWFA

Is also shaped by phonology

The relationship between phonological and auditory processing and brain organization in beginning readers

Kenneth R. Pugh a,b,e, Nicole Landi a,c, Jonathan L. Preston a,d, W. Einar Mencl a, Alison C. Austin a, Daragh Sibley a, Robert K. Fulbright a,b, Mark S. Seidenberg a,f, Elena L. Grigorenko a,c, R. Todd Constable a,b, Peter Molfese a, Stephen J. Frost a,*

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c Yale University, Child Study Center, United States
d Southern Connecticut State University, Department of Communication Disorders, United States
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It’s affected by sounds of words, not just spelling.
So, do people read visually or phonologically?

Behavioral studies suggested people activate phonological information automatically. In skilled readers, very hard to inhibit.

Brain studies provide deeper explanation:

Spelling and sound are integrated at the neural level.

Not independent codes. Brain represents a mix of the two.

[Any educational implications you can think of?]
Example: How fast can people read? How can people increase reading speed?

“Speed reading” programs, from Evelyn Wood to Apps, emphasize 2 things:

Take in more words at a time

Evidence from: studies of visual system show limits on perceptual span
Shows that: you can’t “take in more words” unless you figure out how to grow more receptor cells on retina!

Suppress subvocalization?

Evidence from: studies of role of phonology in comprehension
Shows that: it is important to integrating information over time, during comprehension
Example 3: Is reading a “psycholinguistic guessing game?”

Evidence from: eye tracking studies of good and poor readers

Goodman’s proposal was a good description of what poor readers do.
What can be done?

Change the culture?

Change how next-generation teachers, principals, superintendents, Secretaries of Education are trained?

My students need different and much more advanced training than I received. They have to be smarter than me. There’s no shame in needing to know more.

Same thing in education?

Could it happen?
MEDICAL EDUCATION
IN THE
UNITED STATES AND CANADA
A REPORT TO
THE CARNEGIE FOUNDATION
FOR THE ADVANCEMENT OF TEACHING
BY
ABRAHAM FLEXNER
WITH AN INTRODUCTION BY
HENRY S. Pritchett
PRESIDENT OF THE FOUNDATION

Flexner Report, 1910
Medical education in the US.

Flexner report, 1910.

Before: many medical schools (14 in Chicago alone)
Entirely self-regulated; self-created curricula.

Entry did not require high school diploma, college education, or science background

Degree awarded after two years of study.

Characteristics of modern-day medical education closely follow Flexner’s recommendations.
Perhaps neuroscience will be the Trojan Horse.

Whereas there is wide antipathy to behavioral research on reading, people LOVE the brain.

Understanding it requires relevant background, scientific literacy.

Maybe this is the way in.
For more details about these issues, see this article. It also discusses the “Achievement Gap”.

Download from our web site.
http://lcnl.wisc.edu/publications/archive/261.pdf

Or just email me: seidenberg@wisc.edu
Conclusions:

We could be making better use of our science.

Need is great.

Break down the barriers!

Which is why we’re here, right?
Thanks for listening—and for the work you do!
Finis